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Recent Records of Formerly Extirpated Carnivores in Nebraska

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ABSTRACT -- By the early 1900's, several large carnivores had been extirpated from Nebraska as a result of unrestricted hunting and trapping by early European settlers. Recently, there have been several confirmed records of carnivores that were once extirpated from Nebraska. In our study, we present new data for five species that recently were documented in Nebraska: *Lynx canadensis*, *Ursus americanus*, *Canis lupus*, *Puma concolor*, and *Lontra canadensis*. Restoration programs and legal protection afforded to these species in Nebraska and in adjacent states have allowed population numbers to increase. Because of the increase in populations of these carnivores, individuals have begun to disperse into Nebraska or are establishing populations resulting from restoration programs. The reoccurrence of top predators into an ecosystem presents the possibility of effects on the biodiversity in Nebraska.

Key words: biodiversity, *Canis*, carnivore, distribution, *Lontra*, *Lynx*, Nebraska, *Puma*, *Ursus*.

Many of the early scientific expeditions conducted in Nebraska noted the rich mammalian fauna with an emphasis on large mammals (James 1823, Jones 1962, Reiger 1972, Schubert 1981, Moulton 1986, Bogan 1997). However, as European settlers began to occupy parts of the Great Plains, the diversity of large mammals was altered significantly. The disappearance of large grazers, such as American bison (*Bison bison*), have been well documented, but, the loss of large carnivores (Benedict et al. 1996) has received less attention. This group of mammals was targeted because of the value of their fur and/or the threat they posed to domestic livestock and humans (*Homo sapiens*) (Freeman 2005). The loss of

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these highly interactive species undoubtedly caused changes in the ecosystem resulting in a more simplified or degraded system (Soule' et al. 2003). For example, Berger et al. (2001a, 2002b) described the loss of biodiversity within the Greater Yellowstone Ecosystem after the removal of two large terrestrial carnivores, the wolf (*Canis lupus*) and the brown bear (*Ursus arctos*). Also, Ripple and Beschta (2004) found that the mere risk of predation is enough to structure ecosystems and increase biodiversity.

Recently, Benedict et al. (2000) noted that several species of mammals have expanded their geographic ranges in Nebraska and other parts of the Great Plains. They noted recent records of cougar (*Puma concolor*), a species that had been considered extirpated from Nebraska. Since Benedict et al. (2000), additional reports of *P. concolor*, and other carnivores that were considered extirpated in Nebraska, have been received. Although all of the carnivores discussed in our study were once part of the native fauna in Nebraska, the current flora and fauna has existed without these species for a century or more. The compounded effects that the reoccurrence of these carnivores will have on the native biodiversity of Nebraska has not been established. The objectives of our study were 1) to document the confirmed records and sightings of selected carnivores in Nebraska, 2) to map their distributions, 3) to hypothesize as to the cause of these occurrences, and 4) to suggest possible consequences to the biodiversity in Nebraska as a result of the return of these species.

METHODS

The accounts offered by Jones (1964) served as historical references with which to compare current observations. Specimen localities were obtained from the University of Nebraska State Museum (UNSM), the Nebraska Game and Parks Commission (NGPC), and literature sources. All maps were prepared with ArcGIS 9.0. A standard set of cranial measurements was taken with calipers to the nearest 0.1 mm, including greatest length of skull (GLS), condylobasal length (CL), zygomatic breadth (ZB), interorbital breadth (IB), postorbital breadth (PB), mastoid breadth (MB), maxillary width (PW), length of maxillary toothrow (LMT), and breadth across upper canines (C-C). In the sections describing specimens examined and sight records, specimen localities are arranged alphabetically by county and reference locations, by latitude (north to south) with respect to reference location, and by longitude (west to east) at a given latitude.

SPECIES ACCOUNTS

Lynx canadensis (Canadian Lynx)

Specimens examined (2) -- KNOX COUNTY: near Crofton, 1 (UNSM 15587). WASHINGTON COUNTY: Missouri River, near Herman, 1 (UNSM 14277).

Sight records (3) -- KEITH COUNTY: 3 mi N, 10 mi E of Ogallala, 1 (Sam Wilson, NGPC, Lincoln, Nebraska, personal communication). MORRILL COUNTY: 9 mi S, 3 mi W of Alliance, 1 (Jeff Hoffman, NGPC, Lincoln, Nebraska, personal communication); 4 mi W of Lisco, 1 (Sam Wilson, NGPC, personal communication).

Historically, *L. canadensis* was distributed widely but occurred sparingly in Nebraska (Swenk 1908). Jones (1964) reported three records of *L. canadensis* in Nebraska, the most recent in 1917 along the North Platte River near Keystone, Keith County. Probably, *L. canadensis* subsequently was extirpated from Nebraska. The other two records were from northeastern Nebraska, including one captured in 1890 and housed at UNSM (14611). The other record was a sighting in Rock County, 7 mi NE of Bassett in 1915.

Since Jones (1964), five individuals of *L. canadensis* have been documented in Nebraska (Fig. 1). The first was taken in 1974 along the Missouri River, in Washington County (Gunderson 1978). This specimen weighed 23 lbs (10.4 kg), and parts of its axial skeleton are stored at UNSM (14277). A second specimen was obtained in 1983 in Knox County. This specimen was a male that was shot by a NGPC employee. Cranial measurements for this specimen are reported in Table 1. Finally, in the past six years three individuals have been recorded in western Nebraska. The first was trapped in 1999 in Morrill County. The second and third individuals were both trapped in 2005, one in Keith County near Ogallala and the other in Morrill County, south of Alliance. Interestingly, all three specimens were wearing radio collars from the Colorado Division of Wildlife (CDOW). We were unable to gather any further information on the Canadian lynx from Morrill County taken in 1999. However, data were available for the two Canadian lynx collected in 2005. The Morrill County specimen was a female taken by CDOW and NGPC employees using a PVC/chicken wire walk-in trap. Once caught, the Canadian lynx was tranquilized and transported back to Colorado. The Canadian lynx was taken near a farm/ranchland that was littered with old car bodies and implements (Jeff Hoffman, NGPC, personal communication). The Keith County individual was taken by a local trapper using a snare set for coyote (*Canis latrans*). Apparently, it was in excellent physical condition, weighing 30 lbs at time of death. The specimen was a male that had been captured in Alaska and released in southwestern Colorado (Shenk 2005).

By the mid-1970's *L. canadensis* was considered to be absent from the state of Colorado (Shenk 2002). In 1999, the CDOW began a Canadian lynx restoration

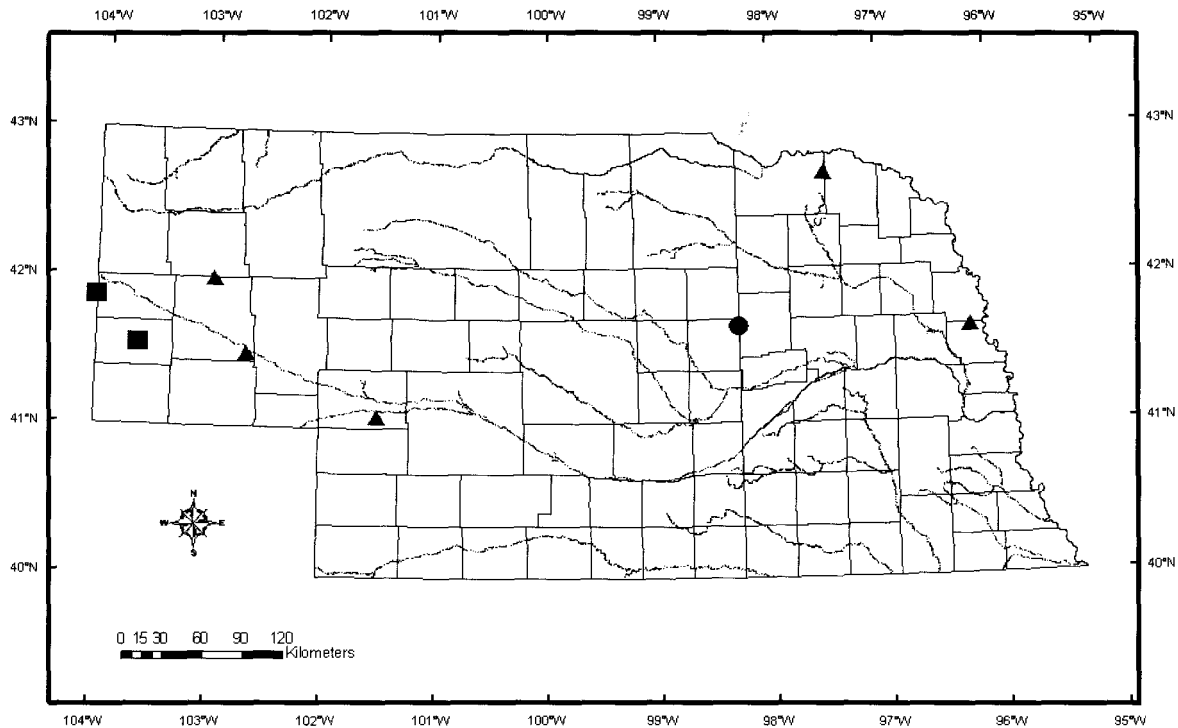


Figure1. Localities of three carnivore species in Nebraska. Triangles represent *Lynx canadensis* localities, squares represent *Ursus americanus* localities, and the circle represents *Canis lupus* locality.

Table 1. Nine cranial measurements (mm) from specimens of four species of carnivores from Nebraska.

Catalogue number and sex	Greatest length of skull	Condylobasal length	Zygomatic breadth	Interorbital breadth	Postorbital breadth	Mastoid breadth	Maxillary width	Length of maxillary toothrow	Breadth across upper canines
<i>Canis lupus</i>									
UNSM 28814, M	---	---	146.0	51.4	---	---	87.2	111.9	52.4
<i>Lontra canadensis</i>									
UNSM 15117, F	110.8	110.8	72.7	26.4	19.9	67.8	40.2	37.2	---
<i>Lynx canadensis</i>									
UNSM 15587, M	130.6	118.6	93.2	26.4	41.2	58.8	57.3	41.8	37.2
<i>Puma concolor</i>									
UNSM 25869, M	199.0	185.0	141.2	40.6	39.3	85.0	85.5	62.3	59.5
UNSM 25870, M	194.5	179.0	---	---	---	---	---	61.8	---
UNSM 27206, M	205.7	186.6	---	---	---	---	---	61.2	---
UNSM 18674, F	181.1	163.6	126.8	35.1	40.2	79.1	77.2	52.8	50.9
UNSM 20909, F	189.6	175.1	129.6	37.4	42.4	80.5	79.2	58.7	55.3

program. Canadian lynx were obtained from Alaska and the Yukon, British Columbia, Quebec, and Manitoba provinces and released into southwestern Colorado in areas near Creede and north of Durango (Shenk 2002). Of 166 animals released in this study, CDOW is tracking 80 individuals and they estimate that there are potentially 105 radio collared individuals currently alive (Shenk 2002, 2005). In 2004, CDOW documented 14 *L. canadensis* litters with a total of 39 kittens, 18 of which were snow tracked. CDOW currently has 29 *L. canadensis* that are waiting to be released in 2005 from a holding facility, with an additional 65 individuals to be released by 2008 (Shenk 2005).

Apparently, *L. canadensis* is dispersing into Nebraska from two areas. Specimens collected in northeastern Nebraska are likely migrants from natural populations of *L. canadensis* found in the Great Lakes region, whereas individuals found in western Nebraska are vagrants from the Colorado restoration program. As populations continue to grow in Colorado, more records of *L. canadensis* in western Nebraska are likely.

Ursus americanus (American Black Bear)

Sight records -- BANNER COUNTY: southwest of Harrison, 1 (Hammel 2002). SCOTTS BLUFF COUNTY: near Henry, 1 (Hammel 2002).

Historically, records of *U. americanus* were restricted primarily to eastern Nebraska along the Missouri River (James 1823). Jones (1964) noted that the accounts of the early exploration parties of Lewis and Clark and J. J. Audubon mentioned American black bear observed along the Missouri River. The last confirmed American black bear was an individual recorded in 1907 near Valentine (Swenk 1908). Since that time, the American black bear has been thought to be extirpated from the state. Reports of the American black bear occurring in the Pine Ridge area and in western Nebraska have been received in recent years, but none of these have been confirmed (Jones 1964).

In 2000, an American black bear sighting in Banner County was confirmed by Gary Schlichtemeier of the NGPC (Hammel 2002). Another American black bear sighting was reported in May 2002 in extreme western Scotts Bluff County (Fig. 1). On the Great Plains, the American black bear is known to occur only in the Black Hills of South Dakota and in eastern Oklahoma (Jones et al. 1985). Using wooded areas along the Platte River as a dispersal corridor, the American black bear in extreme western Nebraska probably is dispersing from the mountains in Wyoming. According to the Wyoming Game and Fish Department's Annual Report of Big and Trophy Game Harvest 2003 (Leonard 2004), there are three American black bear hunting units located in southeastern Wyoming, in the Laramie and Medicine Bow mountain ranges with the Laramie Range located farthest to the east. The North Platte River flows past the north end of the Laramie Mountains only about 80.4 km from the Nebraska-Wyoming border. In 2003, a total of 39 American black bear was

taken from these three hunting units. This illustrates that the American black bear is found in relatively close proximity to Nebraska, with access to suitable dispersal corridors.

In July 2002, there were two reports of other American black bear activity north of Rushville, Sheridan County, in northwestern Nebraska (Hammel 2002). One report claimed to have seen a pair, possibly a mother and cub, 4 miles north of Rushville. A second report came from several local residents, who claim that a single American black bear and its tracks were seen 2 miles north of Rushville, which is located in close proximity to the Pine Ridge. The Pine Ridge is forested habitat with broken terrain and could provide suitable habitat for the American black bear. Also, the Pine Ridge is located relatively close to the Black Hills of South Dakota. Populations of *U. americanus* occur in the Black Hills and surrounding areas (Biodiversity Conservation Alliance 2002, United States Geological Survey 2005). Probably, the American black bear could be dispersing from these areas in South Dakota to Nebraska.

Canis lupus (Wolf)

Specimens examined (1) -- GREELEY COUNTY: 1 mi N, 3.75 mi E Spalding, 1 (UNSM 28814).

Swenk (1908) noted that, prior to European settlement, the prairie wolf (*C. l. nubilus*, a subspecies of the wolf) was abundant in Nebraska, especially in areas that supported large numbers of American bison. Jones (1964) estimated that *C. l. nubilus* was extirpated from the state sometime around 1915 to 1920. Diminishing American bison herds, fur harvesting, and predator control are the most likely causes for the extirpation of *C. l. nubilus*. This subspecies is now thought to be extinct. Since being extirpated, skeletal remains of *C. l. nubilus* have been collected from Nebraska (UNSM 590, 2379, 2380, 3462, 12644); however, there is no way to determine when those individuals died, and thus they merely provide further evidence that *C. l. nubilus* once was widespread in Nebraska (Jones 1964).

Recently a wolf was shot in Greeley County, near Spalding (Fig. 1). The specimen was sent to the United States Fish and Wildlife Services (USFWS), National Fish and Wildlife Forensics Laboratory, Ashland, Oregon, for examination and genetic identification. Results concluded that this specimen was a wolf based on genotypic evidence consistent with wolves originating from the Great Lakes region of Minnesota, Wisconsin, and Michigan (Straughan and Fain 2003). Results from the necropsy report determined that the wolf was a male, weighing 100.2 lbs and in good physical condition. The wolf had a total length of 69 in, body length 52 in, shoulder height 31 in, girth of neck 20 in, girth of chest 31 in, girth of abdomen (bloated) 31 in, head 13.5 in long, and width of head at eye level 6 in. The wolf was shot four times with a .22 caliber rifle, three times in the skull and once in the left hip (Stroud 2003). Because of the severity of damage caused by the

multiple rifle shots, we were only able to record four of the nine cranial measurements (Table 1). Examination of the stomach contents revealed the remains of incisor fragments and hair, which were determined to have come from a deer (*Odocoileus*; Yates 2003).

The above wolf was the first seen in Nebraska since 1913 (Associated Press 2003); however, this specimen undoubtedly represents the subspecies *C. l. lycaon* of the Great Lakes area rather than *C. l. nubilus*, which originally was found in the state. Another wolf moving south was documented in 2001, when a wolf was shot and killed by a bowhunter near Trenton, Grundy County, Missouri. The individual was a male, weighing 80 lbs that originated from Michigan where it had been ear tagged and radio collared. This represented the first wolf found in Missouri since the 1800's (Graham 2001).

***Puma concolor* (Cougar)**

Specimens examined (5) -- BOX BUTTE COUNTY: 5 mi N Berea, 1 (UNSM 25870). HOWARD COUNTY: in Saint Paul, 1 (UNSM 27206). SCOTTS BLUFF COUNTY: 3 mi S, 1.25 mi E of Mitchell, 1 (UNSM 20909). SIOUX COUNTY: 5 mi N, 14 mi E of Harrison, 1 (UNSM 18674); in Harrison, 1 (UNSM 25869).

Sight records (14) -- BROWN COUNTY: north of Ainsworth, 1 (Hoffmann 2002a); near Johnstown, 1 (Porter 2002); TNC Niobrara Valley Preserve, 1 (Jeff Hoffman, Nebraska Game and Parks Commission, personal communication). CHERRY COUNTY: northwest of Valentine, 1 (Nebraska Game and Parks Commission 2005). DAKOTA COUNTY: South Sioux City, 1 (Porter 2004). DAWES COUNTY: near Crawford, 1 (Nebraska Game and Parks Commission 2005a); 5 mi NW of Crawford, 1 (Jeff Hoffman, personal communication); north of Marshland, 1 (Hoffmann 2002b). DOUGLAS COUNTY: 114th Street and West Dodge Road in Omaha, 1 (Morton and Ruggles 2003). HOWARD COUNTY: near Hazard, 1 (Hoffmann 2002b). KEYA PAHA: west of Springfield, near the Cherry/Keya Paha county line, 1 (NGPC 2005a). SARPY COUNTY: along Interstate 80, near Gretna-Louisville exit, 1 (Duggan 2005). SCOTTS BLUFF COUNTY: southwest of Minatare, 1 (Hoffmann 2002b); northeast of Mitchell, 1 (Hoffmann 2002b).

According to Jones (1964), *P. concolor* historically occurred throughout Nebraska but probably was most abundant in the panhandle of western Nebraska. Specimens were found associated primarily with wooded riparian habitats, especially along the Niobrara and Missouri rivers (Swenk 1908). The last confirmed sighting of *P. concolor* in Nebraska was in 1903 south of Crawford, Dawes County. Since then, only unconfirmed sightings were reported until 1991 when a cougar was shot by a deer hunter in northwestern Nebraska near Fort Robinson State Park, in the Pine Ridge (Genoways and Freeman 1996). The specimen was a young female, weighing 35.4 kg and having a total length of 167.64 cm. Five cranial measurements were taken of this specimen by Genoways and Freeman (1996), and

we report four additional measurements (Table 1). Approximately two months before this cougar was killed, a report of cougar tracks and a deer kill made by a cougar was confirmed in western Dawes County (Nebraska Game and Parks Commission 2005a).

Benedict et al. (2000) reported three additional specimens taken in Nebraska after 1991. In 1996, a young male was found dead on railroad tracks in Scotts Bluff County. A full set of cranial measurements for this specimen is shown in Table 1. In 1999, a young male was shot in Harrison, Sioux County, and an adult male was shot north of Berea, Box Butte County. All nine cranial measurements for the Sioux County specimen are reported herein; however, only three measurements are reported for the Box Butte County specimen because of necropsy of the skull that was performed on this individual by the NGPC (Table 1).

After Benedict et al. (2000), 14 additional reports of the species in Nebraska were made (Fig. 2). The first was in February 2000, when the tracks of a cougar were confirmed in southwestern Howard County (NGPC 2005a). The second was in September 2000, when a cougar was seen and tracks were confirmed in northern Scotts Bluff County (NGPC 2005a). The third was a young male that was shot in the town of St. Paul, Howard County, on 20 November 2000 (Bleed 2000). The cougar, which might have been the source of the tracks seen earlier in the county, weighed approximately 114 lbs and was first observed by a group of high school students outside the K to 12 school. Authorities from the St. Paul police department and the NGPC shot the cougar later that day. Examination of the cougar showed that it was in good physical condition, with no evidence of disease or injury (Duggan 2000). Reports showed that the cougar's stomach was empty; however, remains of a mouse and other small animals were found in the intestine. Again, because a necropsy was performed on the skull, only three cranial measurements are reported (Table 1).

A cougar sighting has been confirmed at least once in Nebraska each year from 2001 to 2005. In 2001, a deer hunter (and former NGPC conservation officer) videotaped a cougar feeding on a deer carcass in northern Brown County (Hoffmann 2002a). The cougar was first seen early in the morning along a deer trail. The previous night the cougar had ambushed a deer along the trail and buried the carcass in the snow. The deer was a 4-point (each side) white-tailed buck (*Odocoileus virginianus*) that weighted approximately 170 lbs. The cougar was taped the following night feeding on the deer carcass. In 2002, another cougar was confirmed just 10 miles west of the 2001 cougar, near Johnstown, Brown County (Porter 2002). A picture of this cougar was taken by a trail camera. On 1 October 2003, a cougar was captured near 114th Street and West Dodge Road in Omaha, Douglas County (Morton and Ruggles 2003). The cougar was first observed in a brush pile near I-680. Members of the Omaha Police Department and the Nebraska Humane Society eventually surrounded the cougar and shot it with a tranquilizer dart in the right shoulder. Before becoming sedated, the cougar was shot in the leg

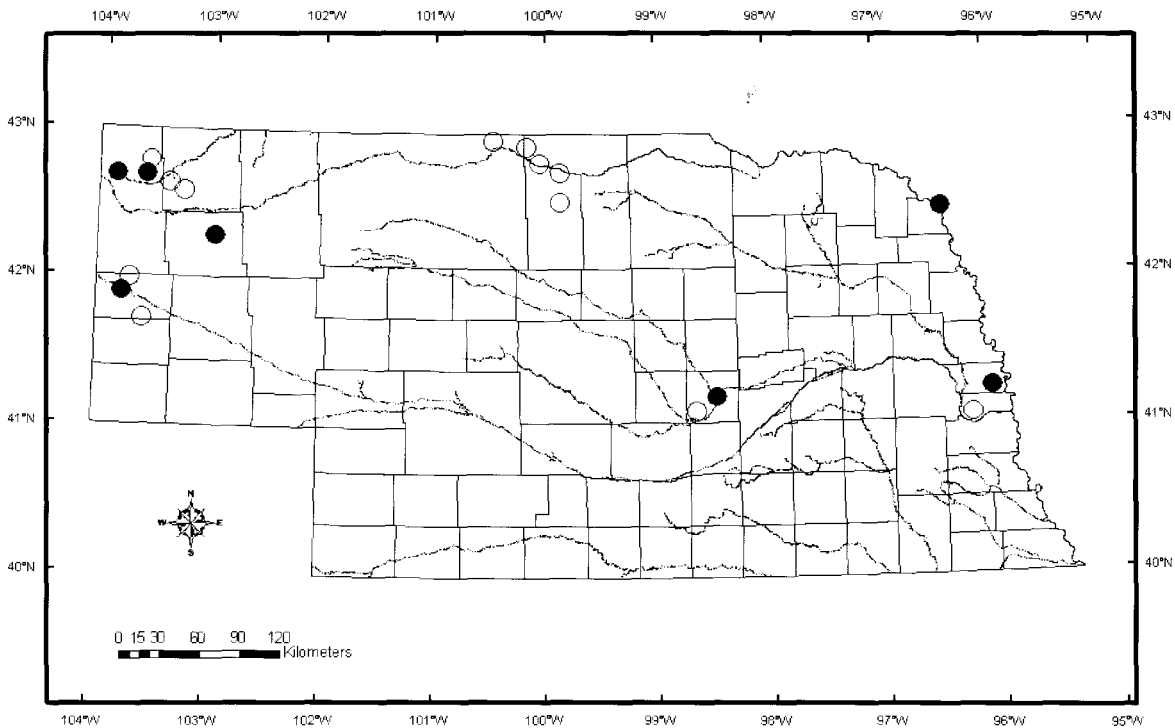


Figure 2. Localities of confirmed *Puma concolor* sightings in Nebraska. Solid symbols represent locations where specimens were collected and deposited within UNSM and open symbols represent locations of confirmed sightings.

with a shotgun as it attempted to escape. This individual, a young male that weighed approximately 80 lbs, is currently being held at the Henry Doorly Zoo, Omaha, Nebraska.

Four sightings of *P. concolor* in Nebraska occurred in 2004 (Nebraska Game and Parks Commission 2005a). In January, a cougar was confirmed visually and tracks were found near Valentine, Cherry County. In May, tracks of a cougar were found in southwestern Dawes County. In September, a photograph of a cougar was taken with a trail camera in western Keya Paha County near the Cherry/Keya Paha county line. Finally, Porter (2004) reported a young male cougar in South Sioux City, Dakota County, on 22 November 2004. The cougar, which was estimated to weigh 100 to 120 pounds, was first seen in a tree in a residential neighborhood. Shortly after being observed, the cougar was shot by the South Sioux City police in order to protect the residents of the area.

In 2005, there have been three confirmed reports of *P. concolor* in the state. A cougar was reported in May at The Nature Conservancy's Niobrara Valley Preserve, located north of Johnstown, Brown County (Jeff Hoffman, NGPC, personal communication). Several unconfirmed reports of a cougar occupying the area had been made before tracks were found and identified by NGPC. In June 2005, a cougar was confirmed from Dawes County, approximately 5 mi northwest of Crawford (Jeff Hoffman, NGPC, personal communication). The cougar was reported by a local rancher, whose domestic dog (*Canis lupus familiaris*) had treed it approximately 60 yards from the rancher's house. Pictures of the cougar were taken by two NGPC employees to confirm the sighting. Finally, on 8 November 2005, an adult male cougar was hit by car and killed along Interstate 80, between Lincoln and Omaha near the Gretna exit, Sarpy County (Duggan 2005).

Based on these records, there have been 19 confirmed cases of *P. concolor* in Nebraska since 1991, and currently there are several reports that are under investigation by the NGPC (Sam Wilson, NGPC, personal communication). Apparently, the cougar is dispersing to Nebraska either from the Black Hills of South Dakota or from Wyoming or both (Genoways and Freeman 1996). Both sources contain large populations of cougar. In 2004, South Dakota Game, Fish and Parks (SDGFP) received 394 reports of cougar sightings, with 55 of those being confirmed and 149 being listed as probable but unverified (South Dakota Game, Fish and Parks 2004). Currently, there are an estimated 140 cougars living in South Dakota (Woodard 2005). Reports from Wyoming indicate that there has been an increase in cougar numbers within the past few years (Hoffmann 2002b). This also can be seen in the number of cougar harvested in Wyoming, which has increased from 105 in 1995 to 199 in 2003, with a maximum of 214 cougars taken in 2001 (Leonard 2004).

Young *P. concolor* typically leave their mothers at about 1.5 to 2 years to establish their own territories and home ranges (Currier 1983). If an area becomes overpopulated, young *P. concolor* might travel large distances to find suitable habitat. Of the eight *P. concolor* for which age class data were available, six were

either juveniles or subadults. Males typically disperse farther from their natal site than do females. Of the eight *P. concolor* for which sex class data were available, six were males. This can be explained by the fact that the home ranges of males do not overlap, thus young males are forced to find areas that are not inhabited already by another male (Seidensticker et al. 1973). Possibly, *P. concolor* in the Black Hills and Wyoming has become so abundant that young *P. concolor* are being forced to disperse into Nebraska where suitable habitat, ample prey (Nebraska Game and Parks Commission 2005b), and low cougar numbers exist. This also seems to be the case for other states, such as Iowa and Oklahoma. As of 2002, there were more than 20 cougar reports filed in Iowa, with some of them being confirmed (Thompson 2002). In 2004, a cougar was found dead along railroad tracks near Red Rock, Noble County, Oklahoma, which is located approximately 40 miles south of the Kansas state line (Pearce 2004, Thompson and Jenks 2005). The cougar was wearing a radio collar, which it had received on 24 February 2003 in the Black Hills of South Dakota. After initially being collared, the cougar traveled 58 miles northwest into Wyoming. From this point, it traveled a straight line distance of 1,067 km to Oklahoma, most likely traveling through parts of Kansas.

Lontra canadensis (North American River Otter)

Specimens examined (38) -- ANTELOPE COUNTY: E of Clearwater near Hackberry Creek WMA, 1 (UNSM 28796); 1 mi E of Clearwater, NE along the Elkhorn River, 1 (UNSM 27749). BROWN COUNTY: Calamus River, 1.0 mi above Rd. from Hwy 7 and Elsmere [T27N, R23W, Sec 33/34], 1 (UNSM 18521); south of Pine WMA, 1 (UNSM 28808). BUFFALO COUNTY: Kearney area, 1 (UNSM 27757); I-80 Kearney exit [T8N, R16W, Sec. 13], 1 (UNSM 28798); Platte River, south of Kearney-Broadfoot Sand and Gravel, 1 (UNSM 28807); 1 mi W of Hwy 10 river bridge, 1 (UNSM 28809); N channel of Platte River, S of Bass WMA, 1 (UNSM 28797); 0.05 mi W Kearney, 1 (UNSM 28792); 0.75 mi W of Hwy 183, S channel of Platte River, 1 (UNSM 28811). CHERRY COUNTY: 10 mi south Merriman on Niobrara River [T33N, R37W, Sec. 29], 1 (UNSM 28793). CUSTER COUNTY: 5 mi SE Callaway, S side South Loup River, 1 (UNSM 27745). FURNAS COUNTY: 6.0 mi S and 4.5 mi W of Beaver City, near Sappa Creek, 1 (UNSM 15117). GARDEN COUNTY: Hwy 26, Blue Creek, 1 (UNSM 28791). GREELEY COUNTY: 2 mi S Ericson [41° 44' 12" N, 98° 32' 47" W], 1 (UNSM 27746). HALL COUNTY: 3 mi S Grand Island on South Locust St., 3 mi W of Hwy 281 on Platte River, 1 (UNSM 28805); Platte River [40° 50' 32" N, 98° 18' 42" W], 1 (UNSM 27751); Wild Rose Ranch [40° 46' 57" N, 98° 28' 13" W], 1 (UNSM 27754); Wood River, 1 (UNSM 28813); Platte River, near Wood River, 1 (UNSM 28795); 4.5 mi S, 2 mi E Wood River, south channel of Platte River [40° 45' 14" N, 98° 33' 32" W], 1 (UNSM 27758). HOLT COUNTY: Elkhorn River, near Emmet, 1 (UNSM 18518); 2 mi N, 2 mi N Ewing, 2 (UNSM 27744, 27750); 2 mi SE Ewing on Cache Creek [42° 14' 00" N, 98°

18° 14' W], 1 (UNSM 27743). KEARNEY COUNTY: E of Interstate structures in ditch south of Platte River [T8N, R15W, Sec 20, N1/2], 1 (UNSM 27756). LINCOLN COUNTY: E of North Platte, S of Brady, 1 (UNSM 28801). LOUP COUNTY: Calamus Reservoir, 1 (UNSM 18520); N side of Calamus Reservoir, 1 (UNSM 18520). MADISON COUNTY: 2.5 mi E Battle Creek on Elkhorn River, 1 (UNSM 28799). MERRICK COUNTY: Central City, Platte River [41° 04' 52" N, 97° 59' 45" W], 1 (UNSM 27755); Platte River near Central City, 1 (UNSM 28806); near Palmer bridge, Palmer, 1 (UNSM 28810). MORRILL COUNTY: 0.5 mi W of Broadwater bridge, 1 (UNSM 28794). OTOE COUNTY: 0.5 mi W Nemaha River [T7N, R12E, Sec. 20, NW1/4], 2 (UNSM 28803, 28804); 3 mi E of Nemaha River [T7N, R13E, Sec. 20, NW 1/4], 1 (UNSM 28802). SAUNDERS COUNTY: Platte River, Hwy 64 bridge near Lashara, 1 (UNSM 18519). SCOTTS BLUFF: Rd 28 and Hwy 25, West of Minitare, 1 (UNSM 28800). WHEELER COUNTY: near Ericson, Cedar River [41° 47' 11" N, 98° 41' 56" W], 1 (UNSM 27753).

Being found in most major waterways (Swenk 1908), *L. canadensis* was common in Nebraska in the 1880's. However, by the early 1900's, populations had been reduced greatly and the last reported specimen of *L. canadensis* was taken in 1916 in Seward County (Jones 1964). Subsequently, *L. canadensis* was considered extirpated from Nebraska and elsewhere over most of its former geographic range on the Great Plains (Jones 1964). Because of its valuable fur, *L. canadensis* was sought highly by early fur trappers. Overexploitation by trapping as well as pollution of streams and deterioration of suitable bank habitat led to the decline of *L. canadensis* (Melquist and Dronkert 1987).

More recently, Farney and Jones (1978) reported that a female North American river otter was trapped west of Beaver City, Furnas County (Fig. 3). The specimen, weighing 18.6 lbs, and measuring a total of 46 in, was reported to be in good physical condition. Eight of the nine cranial measurements for this specimen are reported in Table 1. We were unable to measure the breadth across upper canines because this specimen had developed an infection of the right upper canine, which resulted in the root cavity being opened and the alveolus was eroded away. This resulted in malocclusion of the other teeth and unusual tooth wear. Because this individual probably represents the last natural occurrence of *L. canadensis* in Nebraska, cranial measurements are reported for this specimen only. Bowles (1975) reported a specimen taken near Council Bluffs, Iowa, in 1969 along the Missouri River.

In 1986, the NGPC began a North American river otter restoration program (Bischof 2003). Between 1986 and 1991, 159 individual *L. canadensis* were released in Nebraska. The individuals were livetrapped in Alaska, British Colombia, Idaho, Louisiana, Michigan, Ontario, and Wisconsin, and released at seven sites along seven rivers across the state (Bischof 2003). Subsequently, the North American river otter has dispersed to the Middle Loup and the Little Nemaha rivers. Andelt (1988) reported on the movements of North American river otter that was released

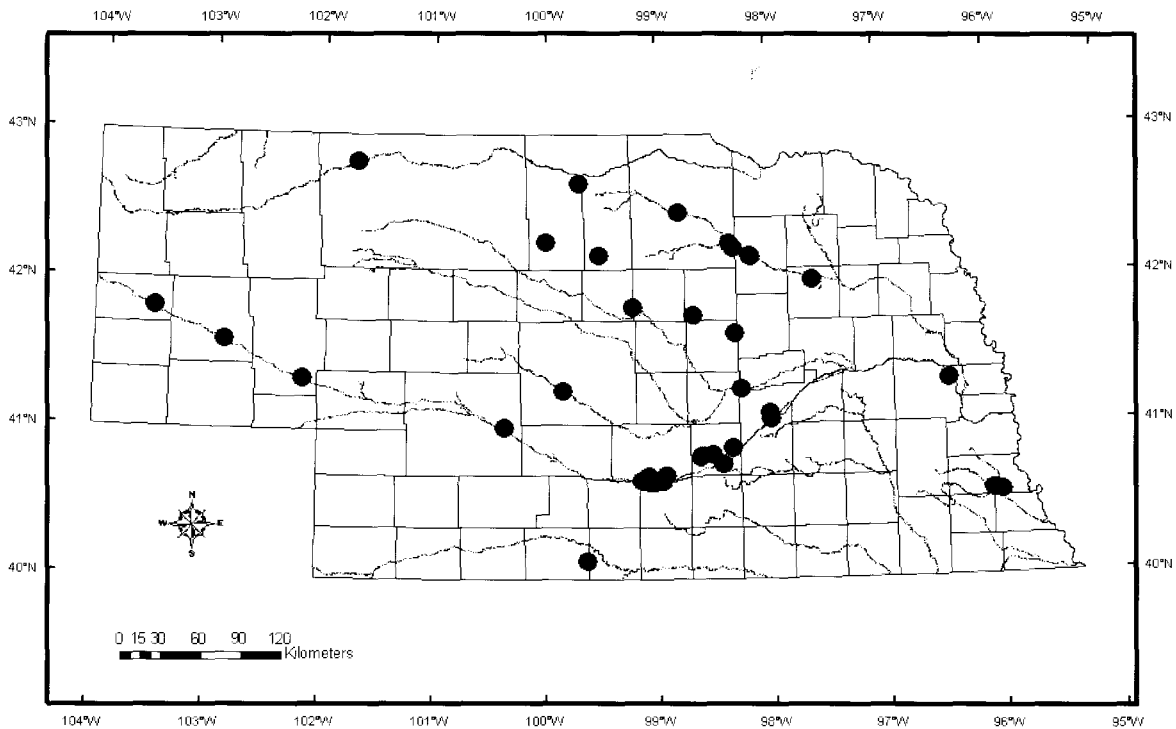


Figure 3. Localities of *Lontra canadensis* collected in Nebraska.

in Nebraska. He noted that one North American river otter moved 324 km from the Calamus River in Loup County to the Platte River in Douglas County. Another, released on the South Loup River in Custer County, was found on the Missouri River in Warren County, Missouri. The distance traveled by this individual was a total of 1138 km by river.

Since 1987, *L. canadensis* mortalities have been reported each year (Bishcof 2003). Of the 109 mortalities reported, 39 were identified as released individuals because each was fitted with an ear and/or web tag before being released; thus, the majority of dead North American river otter were those born in Nebraska. Accidental trapping, resulting in 85.6% of the mortalities (Bishcof 2003), was the primary cause of death. In 1986, *L. canadensis* was designated as an endangered species in Nebraska (Nebraska Game and Parks Commission 2005c). Given that the majority of dead *L. canadensis* that have been recovered were not those that were originally released, *L. canadensis* clearly is reproducing successfully in Nebraska. Most of the specimens that were examined in our study were found to be in good physical condition. This indicates that populations of *L. canadensis* are sustaining themselves in Nebraska. With the restoration of *L. canadensis* into neighboring states (Raesly 2001) and their designated protection, possibly a self-sustaining wild population of *L. canadensis* will continue to exist in Nebraska.

DISCUSSION

New distributional records were reported for five species of carnivores that once occurred in Nebraska prior to European settlement, but have since been extirpated (Jones 1964). We suggest that this dispersal is the result of two conservation practices. The first is restoration programs that were implemented or currently are being implemented in Nebraska and its neighboring states. Most notably is the program for the North American river otter. In 1986, Nebraska began a widespread North American river otter restoration program. Since 1991, when the program stopped, the North American river otter population in Nebraska has been reported as stable (Raesly 2001). The increase in mortalities reported to NGPC within the past few years suggests that individuals are reproducing and population size is increasing. Additionally, all states adjacent to Nebraska have implemented successful restoration programs for North American river otter, except for Wyoming, where native populations of North American river otter already exist (Raesly 2001). Possibly, individuals from neighboring states have dispersed into Nebraska and vice versa. Andelt (1988) noted that the North American river otter is capable of such long range movements. Another species that seems to have benefited from restoration is the Canadian lynx. We are certain that recent specimens taken in western Nebraska were the result of Colorado's Canadian lynx restoration programs. As populations continue to grow in Colorado, individuals of

Canadian lynx will almost certainly continue to disperse into western Nebraska. However, whether or not sustainable Canadian lynx populations will be established in Nebraska is still uncertain.

The second factor enhancing populations of carnivores in Nebraska is the legal status afforded to them. One of the primary reasons for the decline and extirpation of the above species was the unregulated hunting, trapping, and control programs of these species by early settlers and fur trappers (Benedict et al. 1996, Freeman 2005). The wolf is currently listed as endangered by the United States Fish and Wildlife Services. The remaining four species are all protected in Nebraska. In Colorado and Wyoming, the North American river otter and Canadian lynx are protected species, which cannot be harvested, whereas the cougar and American black bear have set seasons and regulations for hunting. Missouri has implemented a North American river otter trapping season with set regulations, with all other species being protected. Kansas, South Dakota, and Iowa have regulations against the harvesting of any of the species examined in our study. The protection and restrictions that are applied to these species have allowed them to increase their respective population sizes. As populations become larger, individuals will disperse to areas of suitable habitat to avoid overcrowding.

The combination of restoration programs and the restrictions and protection with regard to hunting and trapping of these species have allowed them to become more numerous in Nebraska and adjacent states. Because of increased abundances, individuals have begun to disperse into Nebraska or in the case of the North American river otter, establish viable populations. All of these species were once noted as part of the native mammalian fauna in Nebraska (Jones 1964), thus as populations continue to increase, these carnivores that were once extirpated will continue to reclaim parts of their native geographic range in Nebraska.

As these species begin to reoccupy parts of their former geographic range, several issues involving conservation and biodiversity can be raised. All five species discussed in our paper could be considered top predators within their respective ecological communities. Thus, it is critical to ask "What effect will these species have on the biodiversity of Nebraska?" One might think that biodiversity should increase naturally with the addition of these five species. However, since Nebraska has been essentially devoid of large mammalian predators for the last 100 years, how biotic communities will respond to the reoccurrence of these carnivores is unknown.

Similar situations have occurred in areas such as Yellowstone National Park, where a top carnivore, *C. lupus*, was extirpated in the mid 1920's and then restored in 1995 (Phillip and Smith 1996). Since the restoration program began, Yellowstone National Park has experienced a decline in native ungulate numbers (Ripple and Beschta 2004) and a subsequent increase in native avian diversity (Berger et al. 2001a) due to less browsing pressure. Currently in Nebraska, deer populations are the largest ever recorded (Nebraska Game and Parks Commission 2005b). With the

recent occurrences of *P. concolor* and *C. lupus* in Nebraska, opportunities exist for studying the effects of these predators on Nebraska's deer population and the ensuing effects on other native populations such as birds.

Conversely other evidence suggests that the reoccurrence of top predators into a system will cause a decrease in diversity (Fowler and Lindstrom 2002). Ecological communities in Nebraska have been without these large carnivores for approximately 100 years. The potential consequence of this is that prey have become naïve, and no longer have the ability to elude these predators (Berger et al. 2001b). In Nebraska, a likely example of the above situation are aquatic systems. We have shown evidence that North American river otter has established populations and expanded to previously unoccupied river systems. The main diet for North American river otter is fish, frogs, and invertebrates such as crayfish (Jones et al. 1983). Fish species that are most readily taken, include rough, slow moving species such as common carp (*Cyprinus carpio*) and suckers (*Moxostoma* spp.). From a fisheries management perspective, this could be a positive outcome, since carp and suckers are not highly valuable species for anglers. However, several species of game fish do feed on crayfish and various species of frogs, which could be affected by North American river otter predation. Thus the reduction or removal of these species from an area might have adverse effects on the present aquatic community.

Currently, the overall effects that these carnivores will have on the biodiversity of Nebraska's flora and fauna are difficult to ascertain. As populations of these large predators continue to increase, certainly the frequency of interactions between them and their prey will increase and intensify. Future research needs to be conducted in order to investigate these interactions and what overall effects they will have on the biodiversity in Nebraska.

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